Chapter 7

7. PHYSICAL NATURAL RESOURCES AND CLIMATE

7-1 Topography

Fort Greely lies north of the Alaska Range, in the Tanana River watershed. The area has a number of features associated with past and present glacial activities, including terminal moraines, outwash fans, braided streams, kettle lakes, and loess deposits. The Main Post, as well as the East Training Area and the northern half of the West Training Area, lies within the Tanana-Kuskokwim lowland. The entire lowland area is a structural basin. It subsided as the Alaska Range rose to the south and then filled with materials eroded from those mountains. The area consists of alluvial fans that slope northward from the mountains and drop 20 to 50 feet in elevation per mile until they reach the flood plain along the Tanana River. The terrain consists of generally flat lowlands, ranging from 1,200 to 1,600 feet above sea level (Figure 7-1).

The southern half of the West Training Area primarily lies within the Northern Foothills of the Alaska Range. The area is characterized by flat-topped ridges that are oriented west to east and range from 2,000 to 4,500 feet in elevation. Ridges are three to seven miles wide and five to twenty miles long, and are separated by rolling lowlands ranging from 700 to 1,500 feet in elevation, and spans two to ten miles in width. The foothills are largely unglaciated, although glaciers from the Alaska Range widened valleys. In the southwestern portion of the West Training Area, elevations range from 4,000 to 6,200 feet, and some valley glaciers extend onto the installation (Anonymous, 1979).

7-2 Geology

Climatic fluctuations during the Quaternary Period caused glacial expansion and recession (Racine and Walters, 1991). While central Alaska was not glaciated, glaciers during glacial advances surrounded the area. Rivers flowing from glaciers deposited several hundred feet of silt, sand, and gravel in the Tanana and Yukon valleys. Most northern portions of Fort Greely are composed of these Quaternary deposits. A complex assemblage of Precambrian and Paleozoic-aged metamorphic rocks of the Yukon-Tanana crystalline complex (formerly known as Birch Creek schist) characterizes bedrock of the Northern Foothills. These rocks were later intruded by Cretaceous and Tertiary-aged igneous rocks, resulting in a few exposed areas of granite and quartz diorite (Anonymous, 1979).

7-3 Seismicity

Even though seismic activity in Alaska exceeds that found in any other state, few shocks have caused severe damage because of the absence of large population centers. Fort Greely lies in a 200-mile wide seismic zone that extends from Fairbanks southward through the Kenai Peninsula. Since the 1960s, several minor seismic events occurred on the East and West Training Areas. There is no record of damage sustained from these events. The Denali Fault extends through the Alaska Range just south of the installation (Anonymous, 1979).

7-4 Petroleum and Minerals

Petroleum and mineral rights management on withdrawn lands is the responsibility of the BLM. Many glacial deposits in the area are good sources of sand and gravel for aggregate or base course materials. They were used for construction of the Richardson and Alaska highways and the Trans Alaska Pipeline.

In 1942, a gold and molybdenum deposit was found along Ptarmigan Creek in the southwestern portion of the West Training Area. Ore was mined from this deposit, but it was never shipped. Other deposits of gold, lead, and tin have been reported from areas surrounding the post (BLM and U.S. Army, 1994). Portions of the withdrawn lands have moderate to high potential for placer gold deposits. Localized placer deposits may also occur in streams draining the granites and Tertiary-age gravel benches (CEMML, 1998).

The Jarvis Creek coalfield is located southeast of the East Training Area. Coal resources in that area are estimated to be 76 million tons; two-thirds of which occur at depths of less than 1,000 feet. A few hundred tons of coal were extracted from one small mine in the Jarvis Creek field in 1958. The mine provided all the coal requirements at Fort Wainwright and Eielson Air Force Base for at least one year and was active from 1966 to 1972 (Anonymous, 1979).

Four areas of Fort Greely are described in the *Resources Management Plan/Final Environmental Impact Statement* (BLM and U.S. Army, 1994) as having mineral potentials. They include: 1) the Middle Tanana Basin, which occupies the northern and northeastern strip of the installation and encompasses approximately 30% of the post; 2) the Nenana Coal Basin, which lies in the southern and southwestern portions and encompasses about 40% of Fort Greely; 3) a Nonbasin Area occupies a strip between the Middle Tanana Basin and the Nenana Coal Basin, about 20% of the post; and 4) igneous/metamorphic rock outcrops occupy two areas in the southwestern corner of the post (BLM and U.S. Army, 1994).

Coalfields are scattered throughout the Nenana Coal Basin, and it has a high potential for producing coal. Whereas the central Nonbasin Area has low potential, the northern Middle Tanana Basin has moderate potential, and the outcrops have no potential (BLM and U.S. Army, 1994). The potential of finding economic deposits of Tertiary coal on Fort Greely is unknown due to poor outcrops, a lack of subsurface information, the extensive erosion of Tertiary sediments, and structural deformation of the bedrock (CEMML, 1998).

Coal and organics within the Tertiary sediments could generate and trap gas under suitable geologic conditions. The Nenana Basin, with its known coal deposits, has moderate potential for producing gas (CEMML, 1998).

Granitic plutons occur near the eastern and western borders of Fort Greely. Elsewhere in Alaska, these features are associated with thermal springs. Fort Greely is classified as having moderate potential for geothermal resources (BLM and U.S. Army, 1994).

The rock outcrops have no potential for phosphate, sodium, potassium, or gilsonite, while other areas have low potential for these minerals.

The Fort Greely Resources Management Plan (BLM and U.S. Army, 1994) prohibits mining in drop zones and landing fields, and within one mile of existing roads and major trails to maintain safe military operations and training. Mineral material sites are an exception to the one-mile off-limits designation. The military may mine sand and gravel for its own purposes.

Measures to safeguard resource values outlined in 43 CFR 3100, 43 CFR 3600, and 43 CFR 3809 apply to mineral development on withdrawn lands. Under terms of the Military Lands Withdrawal Act of 1986, should withdrawn lands be opened to mineral location, mineral patents could convey title to locatable minerals only. These patents would carry the right to use as much of the surface as necessary for mining under guidelines established by the Secretary of the Interior by regulation (BLM and U.S. Army, 1994).

The Fort Greely Resource Management Plan (BLM and U.S. Army, 1994) continues the exemption of withdrawn lands from provisions of the 1872 Mining Law, the 1920 Mineral Leasing Act (as amended), the 1947 Mineral Leasing Act for Acquired Lands, and the 1970 Geothermal Steam Act. Withdrawn lands are closed to all forms of mineral material disposal, both sale and free use, other than to support military activities.

7-5 Soils

Few soils on Fort Greely have been mapped in detail, with the exception of areas near the cantonment area. In general, soils derived from glacial actions and were modified by streams and discontinuous permafrost. The NRCS (formerly the Soil Conservation Service) identified 12 soil associations in the area of Fort Greely (Figure 7-5, Table 7-5). Soils in the northern, west-central, and eastern portions of the West Training Area are silt loam associations, while the East Training Area is predominantly shallow silt loam over gravelly sand. Soils in the river

Table 7-5. Brief description of the identified 12 soil associations found in the area of Fort Greely (Rieger et al., 1979).

Soil Map Unit	Soil Type	Location	Description
1	Typic Cryochrepts in association with Aeric Cryaquept	High terraces, outwash plains, and footslopes - north part of Fort Greely.	Silt loams, moderately to well-drained with underlying gravelly sand.
2	Histic Pergelic Cryaquepts	Broad rolling hills and valleys in the northwest portion of Fort Greely.	Poor-draining silt loam soils with textures ranging from sand loam to clay loam and are fairly gravelly in areas.
3	Histic Pergelic Cryaquepts in association with Typic Cryofluvents	Level flood plains along the Delta and Tanana Rivers.	45% - poorly-drained loams with textures of either silt loam or sandy loam. 35% - alluvial soils of stratified silt loam and sand. Remainder of the soil consists of peat deposits with shallow loam materials over very gravelly sand located in depressions within the floodplain.
4	Afic Cryochrepts in association with Histic Pergelic Cryaquepts	Uplands north of Fort Greely	35% - well-drained deep silt loams. 20% - poorly-drained silt loams with an overlying peat layer and a shallow permafrost table. 10% - moderately-drained silt loams and well-drained shallow silt loams over bedrock. Remainder – poorly-drained shallow silt loam underlain by permafrost (north facing).
5	Typic Cryochrepts in association with Histic Pergelic Cryaquepts	Uplands to the north of Fort Greely.	30% - very gravelly silt loam or very gravelly loam. 25% - poorly-drained silt loams with overlying peat. Remainder - a mixture of soil types including gravelly and stony silt loams to silt soils.

Soil Map Unit	Soil Type	Location	Description
6	Pergelic Cryaquepts in association with Pergelic Cryochrepts	Foothills and moraines of the Alaska Range in the southern part of Fort Greely.	40% - poorly-drained gravelly and stony loams. 35% - well-drained gravelly and stony loams. Remainder – poorly-drained silt loams.
7	Histic Pergelic Cryaquepts	Low slopes subject to seepage and in drainageways in the southwestern and southeastern portions of Fort Greely.	Poorly-drained shallow loams with permafrost over very gravelly and stony loam. An overlying peat layer is also present.
8	Typic Cryochrepts in association with Histic Pergelic Cryaquepts	Hilly portions along the Delta River in the eastern portion of Fort Greely.	45% - well-drained silt loams. 30% - poorly-drained shallow silt loams. Remainder - a mixture of very gravelly loams and silt loams.
9	Typic Cryochrepts	Terraces, outwash plains, and low moraines along Jarvis Creek.	70% - shallow silt loams. 30% - shallow loams or gravels and poorly-drained silty to gravelly soils.
10	Typic Cryochrepts	Hilly and steep moraines northeast of the Air Drop Zone.	65% - shallow silt loams. Remainder - gravelly loams.
11	Rocklands	Mountainous areas and foothills of the Alaska Range in the southern portion of Fort Greely.	75% - rockland. Remainder - very gravelly shallow soils.
12	Typic Cryochrepts in association with Histic Pergelic Cryaquepts	Moraines and footslopes to the east of Jarvis Creek.	65% - gravelly silt loams over very gravelly loams. Remainder - gravelly, stony silt loam or sand loam.

flood plains consist of alternate layers of sand, silt loam, and gravelly sand. Highly organic wet soils and a high water table characterize muskeg soils, or they are underlain by permafrost. Upland foothills have moist, loamy soils, while mountain soils are rocky, steep, and unvegetated. Lowland soils have moderate erosion potential, while foothill soils have moderate to high erosion potential (Anonymous, 1979). Section 12-2e discusses plans for conducting a soil survey over the next five years.

Permafrost is defined as any ground that remains at or below freezing continuously for more than two years. It is a major factor influencing the distribution of vegetation and human activities. Permafrost is defined in seven categories in order of increasing ice content. The propensity for subsidence and frost action is proportional to the silt content of the soil.

Any activity that removes the insulating vegetation mat or destroys the active layer above the permafrost table allows the ice mass to melt and irregular subsidence to occur. Once started, the thawing process is difficult to control. Maneuver or construction activities could result in this type of damage. The preferred method for developing on permafrost lands is to clear the land of vegetation and then leave it undeveloped for a year to allow the ice to melt. Developed sites should have the lowest possible ice content, and steps should be taken to ensure adequate ground insulation (Nakata Planning Group, 1987). Isolated patches of permafrost exist under Fort Greely's sandy gravel from 2 to 40 feet below ground level. Thickness of permafrost varies between 10 to 118 feet. Existing and abandoned river channels, lakes, wetlands, and other low-lying areas are also permafrost-free (Williams, 1970).

7-6 Water Resources

7-6a Surface Water

Fort Greely's surface waters are diverse and include numerous rivers, streams, ponds, and lakes. Figure 7-6a indicates surface drainage on Fort Greely.

7-6a(1) Rivers and Streams

Fort Greely lies entirely within the Tanana River drainage basin. Surface water from around the Main Post drains into the Delta River and Jarvis Creek. The West Training Area drains into the Delta River, Delta Creek, East Fork of Little Delta River, Buchanan Creek, and the Little Delta River. The Delta River, Delta Creek, and Little Delta River all drain directly into the Tanana River. Surface water from the East Training Area drains into Granite, Ober, and Jarvis creeks. The Gerstle River Test Site drains into the Gerstle River and Sawmill Creek, both of which drain into the Tanana River.

Glaciers that lie along or just south of the installation's southern boundary feed most rivers, streams, and creeks. Glacial melt waters feed the Delta River, Delta Creek, and the Little Delta River from the Alaska Range. Principal glaciers include Canwell, Castner, and Black Rapids (which drain into the Delta River); Trident and Hayes (which drain into Delta Creek); and Hayes and Gillam (which drain into the Little Delta River). Jarvis Creek is fed by melt water from glaciers on Mt. Silvertip (Anonymous, 1979).

The volume of surface water flow fluctuates dramatically by season. From October to May, flow is limited to groundwater seepage from aquifers into streams, and many small streams freeze solid (zero discharge). Snowmelt typically begins in May and reaches its peak in June. Flows are greatest during June and July. After July, most of the snow has melted, and a steady flow during August and September is sustained by rainfall.

The state of Alaska has not designated streams on Fort Greely into water-use categories. Without such designations, fresh waters in Alaska are considered to be in their original and natural condition and suitable for all uses. The pH levels in the Delta River and Jarvis Creek are slightly alkaline, but they are within limits established by the state. Dissolved oxygen levels generally vary with water flow; oxygen levels are highest in June, July, and August and they may approach zero during periods of prolonged ice cover (Bonito, 1980; Anonymous, 1979).

7-6a(2) Lakes and Ponds

Lakes are abundant on Fort Greely, but information on their water quality is scarce. Water samples collected from Bolio Lake had a pH of 8.8 to 9.2, a level beyond acceptable alkalinity as defined by the state. Most nitrogen in Bolio Lake is in organic forms (0.98 mg/l) with low concentrations of nitrates and nitrate nitrogen (0.02 mg/l). Samples collected from Bolio Lake in August 1975, had dissolved oxygen concentrations of 9.8 mg/l near the surface and 10.0 mg/l at a depth of 15 feet.

ADF&G stocks 15 lakes with fish. Most other lakes on Fort Greely are not suitable for stocking, due to poor accessibility or their susceptibility to freezing. Bolio Lake is stocked and is susceptible to freezing, but it only occurs one in 10 year on average.

7-6b Groundwater Resources

Although surface water is abundant in the Tanana Basin, most of Fort Greely's water is obtained from wells. Potential groundwater supply is greatest in the flood plain alluvium along the Little Delta River, Delta River, Delta Creek, and Jarvis Creek, and in the alluvial fans extending along the northern flanks of the Alaska Range (Figure 7-6b). The surface to groundwater depth at Fort Greely is between 100 and 210 feet. Most wells on the post tap unconfined aquifers found in unconsolidated alluvial deposits. Groundwater recharge is from influent seepage of glacier-fed streams.

7-7 Climate

Fort Greely has the northern continental climate of interior Alaska, which is characterized by short, moderate summers; long, cold winters; and low precipitation and humidity. Weather is influenced by mountain ranges on three sides that form an effective barrier to the flow of warm, moist maritime air during most of the year. Surrounding upland areas tend to aid drainage and the settling of cold Arctic air into Tanana Valley lowlands.

The Alaska Meteorological Team (AMT) at the Central Meteorological Observatory, Fort Greely monitors weather at the post to support CRTC projects. Average monthly temperatures range from -6.4ºF in January to 60.0ºF in July, with an average annual temperature of 27.4ºF. The record low temperature is -63ºF, and the record high is 92ºF. The average frost-free period is 95-100 days (27 years of AMT data).

Prevailing winds are from the east-southeast from September through March and from the west, southwest, or south from April through August. Average wind velocity is 8.2 miles per hour (mph). The greatest wind speeds occur during winter, with a high of 104 mph recorded in February. Winds are 5 mph or less only 13.6 percent of the time, and wind speeds greater than 60 mph have been recorded in every month. Thunderstorms are infrequent and occur only during summer (20 years of AMT data).

Average annual precipitation is 11.12 inches, which falls over 90.4 days, mostly during summer and early fall. Average monthly precipitation ranges from a low of 0.24 inches in April to a high of 2.38 inches in June. Average annual snowfall is 40.5 inches, with the record being 99.7 inches in 1945 (27 years of AMT data).

Average annual relative humidity is 55 percent with lowest levels occurring during spring and early summer (38 percent during mid-afternoon in May). Heavy fog is relatively common during December and January, with three or more foggy days occurring each month. Temperature inversions can be pronounced in the Delta Junction area, especially when temperatures drop below - 25°F. Ice fog can be expected any time that temperatures drop to -30°F or lower, but ordinarily ice fog will only occur in areas near human settlements where moisture is exhausted by burning fuels (Anonymous, 1979).